SURVEY OF HIGHWAY CONSTRUCTION MATERIALS

IN THE TOWN OF EAST MONTPELIER, WASHINGTON COUNTY, VERMONT

prepared by

Geologic Section, Materials Division

Vermont Department of Highways

in cooperation with

United States Department of Commerce

Bureau of Public Roads

Montpelier, Vermont

December, 1961

Acknowledgments

The work of this project was greatly implemented by the cooperation and assistance of many groups and individuals. The following were particularly helpful in carrying out the project's objectives:

1. Various departments and individuals of the Vermont State Department of Highways, notably the Planning and Mapping Division and the Highway Testing Laboratory.

2. Professor D. P. Stewart of Miami University, Oxford, Ohio.

3. Professor Charles G. Doll, Vermont State Geologist, University of Vermont, Burlington, Vermont.

4. The United States Department of Commerce, Bureau of Public Roads.

History

The Materials Survey Project was formed in 1957 by the Vermont State Department of Highways with the assistance of the United States Bureau of Public Roads. Its prime objective was to compile an inventory of highway construction materials in the State of Vermont. Prior to the efforts of the personnel of the Survey as described in this and other reports, searches for highway construction materials were conducted only as the immediate situation required. Thus, only limited areas were surveyed and no over-all picture of material resources was available. Highway contractors or resident engineers are usually required to locate the materials for their respective projects and have samples tested by the Highway Testing Laboratory. The additional cost of exploration for construction material is passed on to the State in

the form of higher construction costs. The Materials Survey Project was established to minimize or eliminate this factor by enabling the State and its contractors to proceed with information on material sources available beforehand. Prior knowledge of locations of suitable material is an important factor in planning future highways.

The sources of construction materials are located by this Project through ground reconnaissance, study of maps and aerial photographs, and geological and physiographic interpretation. Maps, data sheets, and work sheets for reporting the findings of the Project were designed, keeping in mind their intended use. These maps and data sheets were devised to furnish information of particular use to the contractor or construction man. For maximum benefit, the maps, data sheets, and this report should be studied simultaneously.

Inclosures

Included in this folder are two surface-geology maps; one defining the location of tests conducted on bedrock sources, the other defining the location of tests conducted on granular materials. These maps are derived from 15-minute quadrangles of the United States Geological Survey enlarged to 1:31250 or 1" = 2604'. Delineated on the Bedrock Map are the various rock types of the area. This information was obtained from numerous sources; i.e., Vermont Geological Society Bulletins, Vermont State Geologist Reports, United States Geological Survey Bedrock Maps, Centennial Geological Map of Vermont, as well as other references.

The Granular Materials Map depicts areas covered by various types of glacial deposits (outwash, moraines, kames, kame terraces, etc.) by which potential sources of gravel and sand may be recognized. This information

was obtained primarily from a survey being conducted by Professor D. P. Stewart of Miami University, Oxford, Ohio, who, since 1956, has been mapping the glacial features of the State of Vermont during the summer months. Further information was obtained from the Soil Survey (Reconnaissance) of Vermont, conducted by the Bureau of Chemistry and Soils of the United States Department of Agriculture, and from Vermont Geological Survey Bulletins, United States Geological Survey Quadrangles, aerial photographs, and other sources. On both maps the areas tested are represented by Identification Numbers. Several tests are usually conducted in each area represented by an Identification Number, the number of such tests being more or less arbitrarily determined either by the character of the material tested or by the topography.

Also included in this folder are Data Sheets for both the Bedrock and Granular Materials Survey which contain detailed information for each test conducted by the Project as well as information obtained from other sources, including an active card file compiled by the Highway Testing Laboratory. It was readily apparent that the latter information was gathered over a period of years by many persons and consequently lacks the organized approach and detail required for effective use. The information in the cards varied widely in completeness. Transfer of information from the cards to the Data Sheets was made without elaboration or verification. The locations of the deposits listed in the card files have also been plotted on the maps. However, caution should be exercised wherever this information appears incomplete. Some cards in the file were not used because the information on the location of the deposit was incomplete or unidentifiable. This project does not assume responsibility for the information taken from the card files.

Work Sheets containing more detailed information of each test including a detailed sketch of each Identification Number Area are on file in the office headquarters of this Project, together with the respective Laboratory Reports.

Location

The Town of East Montpelier is located in Washington County in the Central Plateau Physiographic Division, an area of relatively high flat land, broken by narrow, V-shaped stream valleys. The town is approximately 48 miles south of the northern boundary of the state, and 20 miles west of the eastern boundary of the state. It is bounded on the north by Calais, on the west by Middlesex, on the east by Plainfield and Marshfield, and on the south by Barre and Berlin.

Procedure for Rock Survey

The routine employed by the Project in the survey of possible sources of rock for highway construction is divided into two main stages; the office investigation and field investigation. The first is conducted primarily during the winter months and comprises the mapping of rock types as indicated in various reference sources. Many different sources of information were utilized, as indicated in the Bibliography. These references differ considerably in dependability due to new developments and studies contributing to the obsolescence of a number of reports. In addition, the results of samples taken by other individuals are analyzed and the location in which these samples were taken is mapped when possible. In other words, as complete a correlation as possible is made of all the information available concerning the geology of the area under consideration.

The second stage of the investigation is begun in the field by making a cursory preliminary survey over the entire area. The information obtained in this survey, together with the information assimilated in the first stage of the investigation is employed to determine the areas in which the testing and sampling will be concentrated. When a promising source is encountered as determined not only by rock type but also by volume, accessibility, and the existence of a good working face, chip samples are taken with a hammer and submitted to the Highway Testing Laboratory for testing by the Deval Method (AASHO, T-3). It is kept in mind that samples taken by the chip method are often in the weathered zone of the outcrop and consequently may show a less satisfactory test result than the fresh material deeper in the body of the rock structure. When deemed necessary, further samples are taken by drilling to a depth of approximately 3 feet and blasting across the strike or trend of the outcrop. When the material is uniform, and satisfactory tests result from the chip samples, no further drilling, blasting, or sampling is done and the material source is included as being satisfactory.

Discussion of Rock and Rock Sources

The rocks in the Town of East Montpelier are mainly dark gray phyllites grading into schists, slates, and impure limestones. Most of these rocks belong to one of three formations, the Moretown, Northfield slate, and Barton River formations.

The Moretown formation occurs along the western boundary of the town, strikes north-northeast, and dips steeply to the west. It extends for approximately one mile eastward. The rock types are defined as "finely laminated quartz-albite-sericite-chlorite granulite, with thin partings of sericite,

epidote, and chlorite. Carbonaceous slate and phyllite form thick members that grade into the granulite." Identification Numbers 1 through 4 on the Rock Map are representative of the chlorite schist in the Moretown formation, a highly variable rock, abrasions ranging from 1.8% to 26.6%.

East of the Moretown formation, there is a thin band of Northfield slate, extending from the southern to the northern boundary of the town. Approximately 1000 feet in width, it strikes north-northeast and dips steeply to the west. It is defined as "gray to black slate that weathers to yellow or reddish brown on cleavage surfaces." Because of the known poor abrasion qualities, softness, and tendency to split into thin elongated pieces of this type rock, no samples were taken.

East of the Northfield slate is the Barton River formation, extending to the eastern boundary of the town. It strikes generally north-northeast, and dips steeply to the west. The rock is defined as "interbedded gray phyllites and bluish-gray limestones with a dark rusty color on weathered surface, calcareous mica schists." Because of the thinness of the beds, and the impurity of the rock, the rock type was not sampled.

There are a number of granitic dikes in the Barton River formation in the northwest portion of the town, as shown on the Rock Map. These dikes belong to the Adamant granite, which is defined as "medium-to-fine-grained gray granite in sills several hundred feet thick; subsidiary sills and sill-like dikes, a few feet thick, are composed of fine-grained granite." Identification Number 5 on the Rock Map is representative of this type rock, abrasion being 2.9%.

Procedure for Sand and Gravel Survey

The method employed by the Project in the survey of possible sources of sand and gravel for highway construction is divided into two main stages; office investigation and field investigation. The office investigation is conducted primarily during the winter months and comprises the mapping of possible potentially productive areas as indicated from various references. Of these references, the survey of glacial deposits mapped by Professor Stewart proves to be valuable, particularly when used in conjunction with other references such as soil type maps, aerial photographs and United States Geological Survey quadrangles. The last two are used in recognizing and locating physiographic features indicating glacial deposits, and in studying drainage patterns. In addition, the location of existing pits, when known, are mapped. The locations in which samples were taken by other individuals are noted and mapped, when possible.

The second stage of the investigation is begun in the field by making a cursory preliminary survey over the entire area noting areas which show physiographic features giving evidence of glacial or fluvial deposits. These locations are later examined by digging test pits with a backhoe at a depth of approximately 11 feet and again sampling the material. The samples are submitted to the Highway Testing Laboratory where they are tested for gradation and stone wear, the latter by the Deval Method (AASHO T-4-35).

Discussion of Sand and Gravel Deposits

The granular materials of the Town of East Montpelier are found mainly in the eastern part of the town. They consist of sands and gravels, apparently of fluvial origin, chiefly along the Winooski River. There are a number of sand and gravel pits in this area with material acceptable for sub-base of sand and sub-base of gravel.

The material in the central portion of the town, upon investigation, proved to be till in most cases; as a result, no samples were taken.

Approximately two miles north of Montpelier City are two large sand and gravel areas. Upon investigation, these areas proved to be unacceptable sources for sub-base of gravel (see Identification Numbers 15 and 16 on the Granular Map).

Glossary of Selected Geologic Terms

Alluvial - Pertaining to material carried or laid down by running water.

Bioherm - An organic reef.

Breccia - A rock consisting of consolidated angular rock fragments larger than sand grains.

Calcareous - Consisting of or containing calcium carbonate. As combined with rock names indicates a considerable proportion, say 50 percent, of calcium carbonate together with an equal or predominant amount of the material indicated by the rock name.

Delta - A predominantly alluvial deposit built out by a stream into the sea or other body of water. Usually having the typical form of the Greek letter delta.

Dip - The angle which a stratum, sheet, vein, fissure or similar geological feature makes with a horizontal plane, as measured in a plane normal to the strike.

Dolomite - As used in this report it applies to rocks approximating the mineral dolomite in composition or consisting predominantly of the mineral dolomite. Mineralogically, dolomite is a mineral of definite chemical composition, $Ca\ Mg\ (CO_3)_2$; carbon dioxide 47.7, lime 30.4, and magnesia 21.9 percent.

Drift - Rock material of any sort deposited in one place after having been moved from another; as river drift. Specif., a deposit of earth, sand, gravel, and boulders, transported by glaciers (glacial drift) or by running water emanating from glaciers (fluvio-glacial drift) and distributed chiefly over large portions of North America and Europe, esp. in the higher latitudes.

Dune - A heap of sand or other material accumulated by wind. The outward form may be that of a hill or a ridge.

Fluvial - Pertaining to streams or stream action.

Geode - As applied in this report, a rock cavity lined with crystals that are not separable from the surrounding rock.

Gneiss - A term originally applied to a more or less banded metamorphic rock with the mineral composition of granite. As now employed it designates a foliated metamorphic rock with no specific composition implied, but having layers that are mineralogically unlike and consisting of interlocking mineral particles that are mostly large enough to be visible to the eye. Usually gneiss displays an alteration of granular minerals and tabular or schistose minerals with the rock, tending to split along the planes where tabular or schistose minerals predominate.

Granulite - According to current usage of the term in Europe, a granulite is a quartz-feldspar rock of high metamorphic grade, poor or lacking in mica, and characterized structurally by a single regular plane of schistosity, which is easily visible to the eye. The schistosity is determined mainly by parallel orientation of flat lenses of coarse-grained quartz set in a quartzose matrix of smaller equidimensional grains. The term has appeared in older literature with a variety of other meanings and should not be used without explanation.

Kame - A conical hill of stratified drift, deposited at a glacial terminus by glacial streams flowing in or on the ice.

Kame Terrace - An accumulation of stratified drift laid down chiefly by streams between a glacier and an adjacent valley wall.

Lacustrine - Pertaining to lakes.

Limestone - A bedded sedimentary deposit consisting chiefly of calcium carbonate. The most important and widely distributed of the carbonate rocks. The percentage of calcium carbonate ranges from 40 percent to more than 98 percent. Common impurities are clay and sand.

Marine Deposits - Sedimentary deposits laid down in the sea.

Megascopic - Characters of a material that can be perceived by the unaided eye.

Metamorphic Rocks - Rocks that owe their distinctive characters to the transformation of pre-existing rocks, either through intense heat or pressure or both.

Moraine - An accumulation of drift with an initial topographic expression of its own built within a glaciated region chiefly by the direct action of glacier ice.

Normal - Perpendicular to a surface.

Outwash - Stratified drift that is stream built beyond the glacier; laid down by meltwater streams issuing from the face of the glacier ice.

Phyllite - A fine-grained foliated metamorphic rock intermediate between the mica schists and slates, into which it may grade. The cleavage is made possible by the development of a large amount of the potash mica, sericite, which also gives the rock a distinctive silvery appearance. Between the cleavage planes minerals other than mica usually predominate and garnet and pyrite may occur in visible crystals. Phyllite is usually light in color but various darker shades, even black, are found. Practically all phyllites are derived from fine-grained sedimentary rocks by mechanical deformation and recrystallization. The fracture is intermediate between the smooth, even cleavage of slate and the rather splintery fissility of schist; the rock is not as tough as slate.

Pleistocene - The first epoch of the Quaternary period, in general including the time and deposits of the last great glacial epoch, marked by repeated glacial advances and world-wide fluctuations of the sea level.

Quartzite - A firm, compact rock composed of grains of quartz so firmly united that fracture takes place across the grains instead of around them. A metamorphosed sandstone.

Schist - A crystalline rock with a secondary foliation or lamination based on parallelism of platy or needle-like grains. The name refers to the tendency to split along the foliation.

Schistosity - The property of a foliated rock by which it can be split into thin layers or flakes. The property of splitting may be due to alternating layers of differing mineral composition or to preferred orientation and parallelism of cleavage planes of the mineral.

Siliceous - Containing or pertaining to silica (Silicon dioxide, SiO_2) or partaking of its nature.

Slate - A homogeneous, metamorphic rock, so fine-grained that no mineral grains can be seen. Slate splits with a foliation so perfect that it yields slabs having plane smooth surfaces.

Strike - The direction of a line formed by the intersection of a stratum with a horizontal plane.

Surface-Geology Map - A map showing areas of outcrop of geologic formations, both consolidated rocks and the unconsolidated sediments. Its scale is large enough that pits and quarries can be accurately shown and indexed.

Synclinal - Formed by strata dipping toward a common line or plane.

Terrace - A plain, natural or artificial, from which the surface descends on one side and ascends on the other. Terraces are commonly long and narrow, and they border seas, lakes, or interior valleys. A terrace may be built by deposition of sediment from water, it may be cut by the breaking of waves on a shore or the sweeping of currents, or it may be formed by the dislocation of rocks in crustal movements. The descent from river terraces toward the river may be very abrupt, especially in arid regions, the ascent on the other side may be only that of an extensive alluvial slope.

Till - Unsorted drift, or the mixture of rock fragments and fine materials left by melting glaciers.

Bibliography

1. United States Department of the Interior, Geological Survey, Montpelier Quadrangle.

2. United States Department of the Interior, Geological Survey, Barre Quadrangle.

3. United States Department of the Interior, Geological Survey, Plainfield Quadrangle.

4. United States Department of the Interior, Geological Survey, East Barre Quadrangle.

5. "A Survey of the Glacial Geology of Vermont", by D. P. Stewart. Not published.

6. "Soil Survey (Reconnaissance) of Vermont", by W. J. Latimer. United States Department of Agriculture, Bureau of Chemistry and Soils, 1930.

7. "Soil Exploration and Mapping", Highway Research Board, Bulletin 28, 1950.

8. "Survey of Highway Aggregate Materials in West Virginia", Engineering Experiment Station, West Virginia University, Morgantown, West Virginia. December, 1959.

9. "Materials Inventory, Bangor Quadrangle, South Half, September, 1959", University of Maine.

10. "Glacial Geology and the Pleistocene Epoch", R. F. Flint, John Wiley and Sons, 1947.

11. Aerial Photographs.

12. "A Handbook of Rocks", J. F. Kemp, D. VanNostrand Company, Inc., June, 1946.

13. "Rocks and Rock Minerals", Louis V. Pirsson, John Wiley and Sons, Inc. June, 1949.

14. "Glossary of Selected Geologic Terms", W. L. Stokes and D. J. Varnes, Colorado Scientific Society Proceedings, Vol. 16, 1955.

15. "Bedrock Geology of the Montpelier Quadrangle, Vermont", Wallace M. Cady, 1956.

EAST MONTPELIER GRANULAR DATA SHEET NO. 1

Ident. No.	Field Test No.	Year Field Tested	Depth of Sample or Test (ft)	Over-Burden (ft)	Existing Pit	Volume Estimate (cu. yds)	Sieve Analysis % Passing 1½"	#4	#100	#270	Color AASHO T-21	Abrasion AASHO T-4-35	Passes VHD Specs.	Remarks
1	1	1960	0.5-2	0-0.5	No		--	See	Remarks	—	——	--	--	Owner: H. M. Atwood. A large bluff overlooking US 2 to the west & Winooski River to north. Sampled at request of Soils Engineer as possible source of borrow. Sample represents a large area along Route US 2. Test #1 on top of west end of bluff. Sample processed by Soils Lab. 100% passing #10 mesh 95.3 " #40 85.8 " #200 Soil type A-4. Fails for Item 102, common borrow.
2	1A	1960	0-4	0	No		100	100	72.0	11.5	5	--	--	Owner: Thelma Welch. An extensive area of fine sand containing numerous small diggings. Sample also processed by Soils Lab with results as follows: 100% passing #40 mesh 40.2 " #200 20.6 " #270 Soil type A-4. Fails for Item 102, common borrow.
	B	1960	0-4	0	No		—	See	Remarks	—	——	--	--	

EAST MONTPELIER GRANULAR DATA SHEET NO. 2

Ident. No.	Field Test No.	Year Field Tested	Depth of Sample or Test (ft)	Over-Burden (ft)	Existing Pit	Volume Estimate (cu. yds)	Sieve Analysis % Passing 1½"	#4	#100	#270	Color AASHO T-21	Abrasion AASHO T-4-35	Passes VHD Specs.	Remarks
3	1A	1960	0.5-4	0-0.5	No		100	96.0	14.3	1.1	2	--	Sand	Owner: O. Wheeler. Sand with sand bottom
	B	1960	0.5-4	0-0.5	No		--	See	Remarks	—	——	--	Gran. Borrow	Test #1 on north edge of terrace. Sample passes for Item 202 & 102A. Soils sample also taken: 100% passing 3/4" mesh; 99.4 " 3/8"; 98.5 " #4; 96.6 " #10; 83.4 " #40; 2.9 " #200; 1.3 " #270. Soil type A-3. Acceptable for Item 102A, granular borrow.
4	1	1960	0-5	0	No		--	See	Remarks	—	——	--	Gran. Borrow	Owner: C. Tenney. A large sand area. Test #1 on north end of knoll east of garage. Test #1 275' west of old railroad tracks. Sample processed by Soils Lab. Fine sand, clay bottom. 100% passing #10 mesh; 94.2 " #40; 7.0 " #200; 2.5 " #270. Soil type A-3. Acceptable for Item 102A, granular borrow. Possibly acceptable for Item 202, sub-base of sand.

EAST MONTPELIER GRANULAR DATA SHEET NO. 3

Ident. No.	Field Test No.	Year Field Tested	Depth of Sample or Test (ft)	Over-Burden (ft)	Existing Pit	Volume Estimate (cu. yds)	Sieve Analysis % Passing 1½"	#4	#100	#270	Color AASHO T-21	Abrasion AASHO T-4-35	Passes VHD Specs.	Remarks
	2	1960	1-2	0-1	No		--	Not	Sampled	—	———	———	———	Test #2 south of knoll including Test #1. Clay with clay bottom Not sampled.
	3	1960	1.5-6.5	0-1.5	No		--	See	Remarks	—	———	———	———	Test #3 on knoll north of Test #1 above gully. Sample processed by Soils Lab. Fine sand with fine sand bottom. 100% passing #40 mesh 56.4 " #200 37.1 " #270 Soil type A-4. Too fine for Item 102, common borrow.
	4	1960	1-8.5	0-1	No		100	100	33.0	2.0	3	———	Gran. Borrow (Sand)	Test #4 west of Test #3 on west side of gulley. Fine sand with fine sand bottom Fails for Item 202, sub-base of sand. Has 33% passing #100 mesh Acceptable for Item 102A, granular borrow.
5	1	1960	0.5-11	0-0.5	Yes		100	97.7	21.5	3.8	3	———	Gran. Borrow (Sand)	Owner: Ed Clark. An old small pit with face of 22'. Sand in horizontal layers. Sampled top 11' of face in south side of pit. Fails for Item 202, sub-base of sand Has 21.5% passing #100 mesh. Acceptable for Item 102A, granular borrow.

EAST MONTPELIER GRANULAR DATA SHEET NO. 4

Ident. No.	Field Test No.	Year Field Tested	Depth of Sample or Test (ft)	Over-Burden (ft)	Existing Pit	Volume Estimate (cu. yds)	Sieve Analysis % Passing 1½"	#4	#100	#270	Color AASHO T-21	Abrasion AASHO T-4-35	Passes VHD Specs.	Remarks
6	1	1960	———	---	Yes		---	58.0	1.0	0.8	1	21.2	Gravel	Owner: Town of East Montpelier. 60' face of fine sand, sand & gravel layers. Gravel layers are only very small percentage of total face & are deeply buried. One band of gravel is approximately 7' thick but pinches out along the face. Sample from gravel layers. Acceptable for Item 201, sub-base of gravel.
7	1	1960	1-7	0-1	No		---	See	Remarks	—	---	---	Borrow (Gran. Borrow)	Owner: Charles Taylor A large area located within a wide bend of the river. Test #1 taken at southeast edge of area at top of river bank. Very fine sand with silty sand in bottom. Sample processed by Soils Lab. 100% passing #10 mesh 99.4 " #40 25.3 " #200 15.4 " #270 Soil type A-2-4. Fails for Item 102A, granular borrow. Has 15.4% passing #270 mesh. Acceptable for Item 102, common borrow.

EAST MONTPELIER GRANULAR DATA SHEET NO. 5

Ident. No.	Field Test No.	Year Field Tested	Depth of Sample or Test (ft)	Over-Burden (ft)	Existing Pit	Volume Estimate (cu. yds)	Sieve Analysis % Passing 1½"	#4	#100	#270	Color AASHO T-21	Abrasion AASHO T-4-35	Passes VHD Specs.	Remarks
	2	1960	1-7.5	0-1	No		—	See	Remarks	—	——	——	Gran. Borrow	Test #2 west of Test #1 200' east of river bank. Fine sand with fine sand bottom. Sample processed by Soils Lab. 100% passing #10 mesh 99.1 " #40 10.5 " #200 6.5 " #270 Soil type A-2-4. Acceptable for Item 102A, granular borrow
	3	1960	1-9	0-1	No		100	99.6	16.0	2.25	3	——	Gran. Borrow (Sand)	Test #3 585' northwest of Test #1 & 20' west of riverbank. Sand with sand bottom. Fails for Item 202, sub-base of sand. Has 16% passing #100 mesh. Acceptable for Item 102A, granular borrow.
	4	1960	1.5-9	0-1.5	No		100	98.0	5.0	0.25	3	——	Sand	Test #4 150' south of Test #3 & 35' west of riverbank. Sand with sand bottom. Acceptable for Item 202, sub-base of sand.
	5	1960	2.5-9	0-2.5	No		100	98.3	46.0	10.0	2½	——	Gran. Borrow (Sand)	Test #5 150' south of Test #4 & 45' west of riverbank. 0-2.5' silt, 2.5-4.5' sand, 4.5-9' fine sand. Fails for Item 202, sub-base of sand. Has 46% passing #100 mesh Acceptable for Item 102A, granular borrow

EAST MONTPELIER GRANULAR DATA SHEET NO. 6

Ident. No.	Field Test No.	Year Field Tested	Depth of Sample or Test (ft)	Over-Burden (ft)	Existing Pit	Volume Estimate (cu. yds)	Sieve Analysis % Passing 1½"	#4	#100	#270	Color AASHO T-21	Abrasion AASHO T-4-35	Passes VHD Specs.	Remarks
	6	1960	1-8	0-1	No		100	99.1	8.0	1.5	3	—	Sand	Test #6 200' north of Test #4 115' west of Test #3 & 200' east of riverbank. Sand with sand bottom. Acceptable for Item 202 sub-base of sand.
	7	1960	1.5-8.5	0-1.5	No		100	78.5	3.0	0.5	3	—	Gran. Borrow (Sand)	Test #7 60' east of power pole & 25' west of riverbank. 0-1.5' overburden, 1.5-4.5' sand, 4.5-8.5' silt. Fails for Item 202, sub-base of sand. Has only 78.5% passing #4 mesh. Acceptable for Item 102A, granular borrow.
	8	1960	1-7	0-1	No		100	98.2	7.0	0.25	2	—	Sand	Test #8 on knoll northwest of Test #6. Sand with sand bottom Acceptable for Item 202, sub-base of sand
	9A	1960	1.5-8.5	0-1.5	No		100	92.7	31.4	8.1	3	—	Gran. Borrow (Sand)	Test #9 northeast of Test #7 & east of Test #8. Sand & silt with silt bottom. Test #9A fails for Item 202, sub-base of sand. Has 31.4% passing #100 mesh. Acceptable for Item 102A, granular borrow. Sample also
	B	1960	1.5-8.5	0-1.5	No		—	See	Remarks	—	—	—	Borrow (Gran. Borrow)	processed by Soils Lab (Test #9B) Fails for granular borrow, Item 102A, acceptabl

EAST MONTPELIER GRANULAR DATA SHEET NO. 7

Ident. No.	Field Test No.	Year Field Tested	Depth of Sample or Test (ft)	Over-Burden (ft)	Existing Pit	Volume Estimate (cu. yds)	Sieve Analysis % Passing 1½"	#4	#100	#270	Color AASHO T-21	Abrasion AASHO T-4-35	Passes VHD Specs.	Remarks
	10	1960	0.5-7.5	0-0.5	No		—	73.1	5.0	0.75	2	—	Gran. Borrow (Grav)	for borrow, Item 102. Sieve analysis: 100% passing #10 93.6 " #40 25.8 " #200 Soil type A-2-4. Test #10 275' east of Test #9. 0-0.5' overburden, 0.5-3.5' gravel, 3.5-6' sand, 6-7.5' gravel with soft rotted stones. Insufficient stones in sample for abrasion test. Fails for Item 201, sub-base of gravel. Has only 26.9% stone. Acceptable for Item 102A, granular borrow.
8	1	1960	0-3	0	Yes		100	90.7	3.6	1.3	1	—	Sand	Owner: Chas. Taylor. A small pit in a large sand area. Test #1 taken in floor of pit. Coarse sand with coarse sand bottom. Acceptable for Item 202, sub-base of sand.
9	1	1960	1-10	0-1	No		—	See	Remarks	—	—	—	—	Owner: W. Smith. Test #1 on top of northernmost knoll. Fine silt & clay. Sample processed by Soils Lab. 100% passing #10 96.1 " #40 91.0 " #200

EAST MONTPELIER GRANULAR DATA SHEET NO. 8

Ident. No.	Field Test No.	Year Field Tested	Depth of Sample or Test (ft)	Over-Burden (ft)	Existing Pit	Volume Estimate (cu. yds)	Sieve Analysis % Passing 1½"	#4	#100	#270	Color AASHO T-21	Abrasion AASHO T-4-35	Passes VHD Specs.	Remarks
	2	1960	1-10	0-1	No		—	Not	Sampled	—	——	——	——	Soil type A-4. Failed for Item 102, common borrow. Test #2 in southwest corner of field. 0-1' overburden, 1-4' silt 4-5' gravel, 5-10' clay. Not sampled.
	3	1960	1-7	0-1	No		—	Not	Sampled	—	——	——	——	Test #3 on top of knoll in southeast corner of field. Fine sand with clay bottom. Not sampled.
10	1	1960	1.5-11	0-1.5	No		—	42.1	10.0	2.5	1	38.9	Gran. Borrow (Grav)	Owner: Tofani. Test #1 110' west of woods, 75' south of woods & 150' north of fence. 0-1.5' overburden, 1.5-3.5' silt, 3.5-5' gravel, 5.0-7.0' sand 7-11' gravel. Fails on wear for Item 201, sub-base of gravel. Acceptable for Item 102A, granular borrow.
	2	1960	4-9	0-1	No		—	28.6	13.0	4.25	2.5	35.6	Gran. Borrow (Grav)	Test #2 330' west of Test #1. 0-1' overburden, 1-4' silt, 4-9' gravel, 9-10' clay Sampled 4-9'. Fails on wear for Item 201, sub-base of gravel. Acceptable for Item 102A, granular borrow.

EAST MONTPELIER GRANULAR DATA SHEET NO. 9

Ident. No.	Field Test No.	Year Field Tested	Depth of Sample or Test (ft)	Over-Burden (ft)	Existing Pit	Volume Estimate (cu. yds)	Sieve Analysis % Passing 1½"	#4	#100	#270	Color AASHO T-21	Abrasion AASHO T-4-35	Passes VHD Specs.	Remarks
	3	1960	1-4	0-1	No		—	42.6	7.0	2.5	2	33.0	Gran. Borrow (Grav)	Test #3 northwest of Test #2. Gravel with clay bottom. Fails on wear for Item 201, sub-base of gravel. Acceptable for Item 102A, granular borrow.
11	1	1958	——	——	Yes		—	46.3	9.0	3.75	1	16.1	Gravel	Owner: Caledonia Sand & Gravel, Inc. An extensive pit nearly depleted. Plant produces Hot Mix. Test #1 taken by Resident Engineer on construction project. Acceptable for Item 201, sub-base of gravel.
	2	1958	——	—	Yes		—	48.6	3.0	1.75	2	14.0	Gravel	Test #2 taken at pit by Resident Engineer on project. Acceptable for Item 201, sub-base of gravel.
12	1	1960	3-7	0-3	No		—	55.6	—	1.5	1	37.8	Gran. Borrow (Grav)	Owner: Tofani. Test #1 on knoll across road from small red house. 0-3' overburden, 3-7' mixed sand & gravel, 7-9' clay. Sampled 3-7'. Failed on abrasion for Item 201, sub-base of gravel. Acceptable for Item 102A, granular borrow

EAST MONTPELIER GRANULAR DATA SHEET NO. 10

Ident. No.	Field Test No.	Year Field Tested	Depth of Sample or Test (ft)	Over-Burden (ft)	Existing Pit	Volume Estimate (cu. yds)	Sieve Analysis % Passing 1½"	#4	#100	#270	Color AASHO T-21	Abrasion AASHO T-4-35	Passes VHD Specs.	Remarks
13	1A	1960	11-17	0-11	Yes		—	53.9	5.0	2.0	1	—	Gran. Borrow (Grav)	Owner: Ibey. Test #1 in face of pit. 0-11' overburden, 11-17' gravel, 17-25' sand. Test #1A represents sampling of 11-17'. Insufficient stones in sample for abrasion test. Acceptable for Item 102A, granular borrow.
	1B	1960	17-25	—	Yes		100	97.8	5.9	0.3	2	- —	Sand	Test #1B represents sampling of 17-25' sand with coarse gravel bottom. Acceptable for Item 202, sub-base of sand.
	2	1960	0.5-10	0-0.5	Yes		—	34.2	5.0	2.0	2	26.8%	Gran. Borrow (Grav)	Test #2 in bottom of pit below Test #1. 0-3.5' gravel, 3.5-8' sand, 8-10' coarse gravel. Fails on abrasion for Item 201 sub-base of gravel. Acceptable for Item 102A, granular borrow.
	3	1960	0-14	0	No		—	Not	Sampled	—	—	—	—	Test #3 50' west of Test #1. 0-10' silt, 10-14' sand & stones, not sampled.
	4	1960	1-9.5	0-1	No		—	See	Remarks	—	—	—	—	Test #4 in southwest corner of field adjacent to cemetery. Sample processed by Soils Lab.

EAST MONTPELIER GRANULAR DATA SHEET NO. 11

Ident. No.	Field Test No.	Year Field Tested	Depth of Sample or Test (ft)	Over-Burden (ft)	Exist-ing Pit	Volume Estimate (cu. yds)	Sieve Analysis % Passing 1½"	#4	#100	#270	Color AASHO T-21	Abrasion AASHO T-4-35	Passes VHD Specs.	Remarks
														100% passing #40 99.6 " #200 35.9 " #270 Soil type A-4. Fails for Item 102, common borrow.
14	1	1960	5-9	0-5	No		100	97.5	9.7	2.7	2	—	Sand	Owner: Ibey. Test #1 in river bank. Silt overburden. Sand with sand bottom. Acceptable for Item 202, sub-base of sand.
15	1	1960	18-24	0-1	Yes		—	66.2	17.0	0.8	1	—	Gran. Borrow (Grav)	Owner: J. Gasrow. Test #1 in west face of pit where face is highest. Sand and stone with sand and stone bottom. Fails for Item 201, sub-base of gravel. Has 66.2% passing #4 mesh. Has 17% passing #100 mesh. Acceptable for Item 102A, granular borrow.
16	1	1960	1-25	0-1	Yes		—	68.3	15.0	3.8	1	—	Gran. Borrow (Grav)	Owner: Stanley Martin. Test #1 taken at random from face. Stones appear soft, lot of fines, band of coarse gravel at top. Much sand. Fails for Item 201, sub-base of gravel. Has 68.3%

EAST MONTPELIER GRANULAR DATA SHEET NO. 12

Ident. No.	Field Test No.	Year Field Tested	Depth of Sample or Test (ft)	Over-Burden (ft)	Existing Pit	Volume Estimate (cu. yds)	Sieve Analysis % Passing 1½"	#4	#100	#270	Color AASHO T-21	Abrasion AASHO T-4-35	Passes VHD Specs.	Remarks
														passing No. 4 mesh. Acceptable for Item 102A, granular borrow.

EAST MONTPELIER ROCK DATA SHEET NO. 1

Ident. No.	Field Test No.	Year Field Tested	Rock Type	Existing Quarry	Method of Sampling	Abrasion AASHO T-3	Distance Between Samples (ft)	Remarks
1A	1	1958	Schist	No	Blasted	8.5	0	Owner: Cary. Ident. Nos. 1A, 1B, & 1C represent sampling of three distinct cross-sections across the strike of a ledge approximately 430' wide across strike. The ledge is in the Moretown Formation, a chlorite schist ranging from highly foliated to fairly massive. The material is not sufficiently uniform to be considered a satisfactory source. Test #1 of Ident. #1A is approximately 250' right (east) of Station 251+20 of Interstate Project I 89-2 (3).
	2	1958	Schist	No	Blasted	3.9	22	Test #2 120' N 70°E of Station 251 + 00 on centerline of above project & 22' from Test #1.
	3	1958	Schist	No	Blasted	3.9	20	Test #3 20' southeast across strike from Test #2. Material from Test #2 & #3 combined into one sample. A fine grained massive chlorite schist.
	4	1958	Schist	No	Blasted	9.5	38	Test #4 38' east from Test #3 across strike. Foliated chlorite schist.
	5	1958	Schist	No	Blasted	8.3	20	Test #5 20' east across strike from Test #4. Fine grained chlorite schist.
	6	1958	Schist	No	Blasted	2.9	40	Test #6 40' east across strike from Test #5. Feldspar chlorite schist.
	7	1958	Schist	No	Blasted	10.1	30	Test #7 30' east across strike from Test #6. Foliated chlorite schist.

EAST MONTPELIER ROCK DATA SHEET NO. 2

Ident. No.	Field Test No.	Year Field Tested	Rock Type	Existing Quarry	Method of Sampling	Abrasion AASHO T-3	Distance Between Samples (ft)	Remarks
	8	1958	Schist	No	Blasted	4.2	20	Test #8 20' east across strike from Test #7. Fine grained chlorite schist.
	9	1958	Schist	No	Blasted	10.0	94	Test #9 ESE of Test #8.
	10	1958	Schist	No	Blasted	8.2	10	Test #10 southeast of Test #9.
	11	1958	Schist	No	Blasted	8.4	35	Test #11 ENE of Test #10.
	12	1958	Schist	No	Blasted	10.8	36	Test #12 northeast of Test #11.
	13	1958	Schist	No	Blasted	7.4	60	Test #13 SSE of Test #12. Fairly massive quartz chlorite schist.
1B	1	1958	Schist	No	Blasted	6.6	--	Owner: Cary. Ident. #1B represents sampling of section across strike approximately 200' northeast of Ident. #1A. Strike of ledge N32°E, dip 80°W. This section is approximately 200' northeast of Ident. #1A. Test #1 approximately 172' northeast of Test #1, Ident. #1A. Quartz-sericite-chlorite schist.
	2	1958	Schist	No	Blasted	2.6	57	Test #2 57' northeast of Test #1. Quartz-sericite-chlorite schist with black biotite.
	3	1958	Schist	No	Blasted	1.8	51	Test #3 51' SSE of Test #2. Quartz-feldspar-chlorite schist.
	4	1958	Schist	No	Blasted	8.2	46	Test #4 46' ESE of Test #3. Foliated quartz-chlorite schist.
	5	1958	Schist	No	Blasted	7.4	20	Test #5 20' southeast of Test #4. Quartz-feldspar-chlorite schist.
	6	1958	Schist	No	Blasted	6.8	59	Test #6 59' east of Test #5. Fine grain chlorite schist.
	7	1958	Schist	No	Blasted	6.4	28	Test #7 28' SSE of Test #6. Quartz-feldspar-chlorite schist.
1C	1	1958	Schist	No	Blasted	6.1	--	Owner: Cary. Ident. #1C represents sampling of section across strike approximately 300' northeast of Ident. #1B. Ledge has same strike

EAST MONTPELIER ROCK DATA SHEET NO. 3

Ident. No.	Field Test No.	Year Field Tested	Rock Type	Existing Quarry	Method of Sampling	Abrasion AASHO T-3	Distance Between Samples(ft)	Remarks
								and dip as Ident. #1B. Test #1 286' northeast of Test #1, Ident. #1B. Rock similar to rock in Areas 1A & 1B.
	1A	1958	Schist	No	Blasted	10.3-9.2(R)	70	Test #1A 70' ENE of Test #1.
	2	1958	Schist	No	Blasted	19.3-16(R)	29	Test #2 29' southeast of Test #1A
	3	1958	Schist	No	Blasted	7.7	28	Test #3 28' southeast of Test #2
	4	1958	Schist	No	Blasted	7.7	15	Test #4 15' southeast of Test #3
	5	1958	Schist	No	Blasted	11.9-13(R)	21	Test #5 21' southeast of Test #4
	6	1958	Schist	No	Blasted	13.2	30	Test #6 30' east of Test #5.
	7	1958	Schist	No	Blasted	8.4	15	Test #7 15' southeast of Test #6
	8	1958	Schist	No	Blasted	6.3	17	Test #8 17' SSE of Test #7.
	9	1958	Schist	No	Blasted	8.0	21	Test #9 21' SSE of Test #8. (R) indicates rock was resampled from same blast hole.
2	1	1958	Schist	No	Blasted	6.2	100' across strike	Owner: Cary. In general area approximately 1000' northeast of Ident. #1C in ledge of chlorite schist. Location of Tests #1 & #2 uncertain.
	2	1958	Schist	No	Blasted	4.2	100' across strike	
3	1	1957	Schist	No	Blasted	12.2	--	Owner: Wrightsville Dam. Ledge at east end of Wrightsville Dam. Moretown Formation. Schist.
	2	1957	Schist	No	Blasted	8.2	--	Test #2 resample of Test #1.
4	1	1958	Schist	No	Chip	5.8	--	Owner: Lombard. Ledge on south side of railroad opposite cemetery. Moretown Formation. Chlorite schist. Test #1 240' left of Station 234 + 50 on Interstate Project I 002-2 (3). Test #1 preliminary sample.

EAST MONTPELIER ROCK DATA SHEET NO. 4

Ident. No.	Field Test No.	Year Field Tested	Rock Type	Existing Quarry	Method of Sampling	Abrasion AASHO T-3	Distance Between Samples(ft)	Remarks
	2	1958	Schist	No	Blasted	26.6	--	Test #2 between Station 232 and 233. Heavily foliated chlorite schist.
	3	1958	Schist	No	Blasted	8.0	15	Test #3 between Station 232 and 233. Massive green chlorite schist.
	4	1958	Schist	No	Blasted	8.1	16	Test #4 between Stations 232 and 233.
	5	1958	Schist	No	Blasted	8.0	25	Test #5 between Stations 232 and 233.
	6	1958	Schist	No	Blasted	12.6	24	Test #6 between Stations 232 and 233. Fine grain massive green chlorite schist.
5	1	1957	Granite	Yes	Chip	2.9	--	Owner: Arthur Fitch. Sample taken by D. P. Stewart. Small quarry. Rock was granite, estimated quantity 50,000 cubic yards.

EAST MONTPELIER GRANULAR PROPERTY OWNERS

PROPERTY OWNERS	IDENT. NO.
Atwood, H.M.	1
Caledonia Sand & Gravel (Cooley Pit	11
Clark, Ed	5
East Montpelier Town	6
Gasrow, J. SOLD TO STEVE SYZ.	15
Ibey	13
"	14
Martin, Stanley	16
Smith, W.	9
Taylor, Charles	7
" "	8
Tenney	4
Tofani	10
"	12
Welch, Thelma	2
Wheeler, O.	3

EAST MONTPELIER ROCK PROPERTY OWNERS

PROPERTY OWNERS	IDENT. NO.
Cary	1A, B, C
"	2
Fitch, Arthur	5
Lombard	4
Wrightsville Dam	3

N

EAST MONTPELIER

SCALE 1:31,250

0.5 0 MILE

CONTOUR INTERVAL 20 FEET

1961

LEGEND

- ○ GRAVEL, ACCEPTABLE FOR ITEM 201 (sub-base of gravel)
- ● GRAVEL, DEPLETED OR NOT ACCEPTABLE FOR ITEM 201
- △ SAND, ACCEPTABLE FOR ITEM 202 (sub-base of sand)
- ▲ SAND, DEPLETED OR NOT ACCEPTABLE FOR ITEM 202
- □ GRANULAR BORROW, ITEM 102-A
- ■ BORROW, ITEM 102
- ✕ EXISTING PIT
- SG SAND & GRAVEL DEPOSIT
- S SAND DEPOSIT
- 3 IDENTIFICATION NUMBER (refer to data sheets)

GRANULAR MATERIALS MAP

BY

VERMONT DEPARTMENT OF HIGHWAYS

IN COOPERATION WITH

U.S. BUREAU OF PUBLIC ROADS

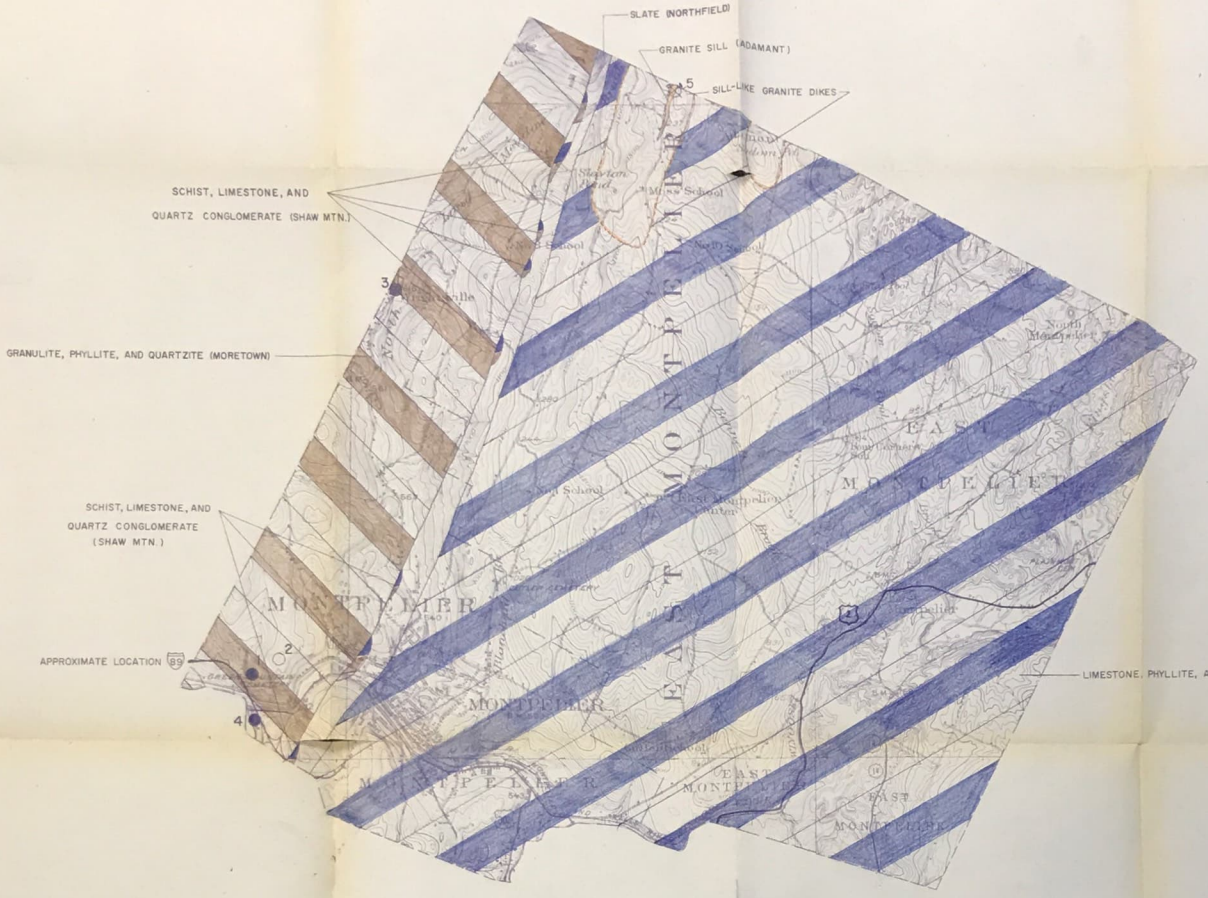
NOTE: BASED ON U.S.G.S. TOPOGRAPHIC MAPS

GRANULAR

WASHINGTON COUNTY VT. HWY. DISTRICT NO. 9

REVISIONS DATE BY

EAST MONTPELIER



EAST MONTPELIER

LEGEND

- ROCK, ACCEPTABLE FOR ITEM 204 (sub-base of crushed rock)
- ROCK, NOT ACCEPTABLE FOR ITEM 204
- EXISTING QUARRY
- GRANITE TO DIORITE (light to intermediate igneous rocks)
- AMPHIBOLITE, GABBRO, DIABASE, METADIABASE, GREENSTONE, TRAP DIKES (basic or dark igneous rocks)
- PERIDOTITE, PYROXENITE, SERPENTINITE (ultra-basic igneous rocks)
- GNEISS
- QUARTZITE
- DOLOMITE
- MARBLE, LIMESTONE
- SCHISTS, SLATES, PHYLLITES, SHALES, CONGLOMERATES
- 3 IDENTIFICATION NUMBER (refer to text)

SCALE 1:31,250

0.5 0 1 MILE

CONTOUR INTERVAL 20 FEET

1961

ROCK MATERIALS MAP

BY

VERMONT DEPARTMENT OF HIGHWAYS

IN COOPERATION WITH

U.S. BUREAU OF PUBLIC ROADS

NOTE: BASED ON U.S.G.S. TOPOGRAPHIC MAPS

ASHINGTON COUNTY VT. HWY. DISTRICT NO. 6

REVISIONS

DATE						
BY						